# The Bottom Line in Greenhouse Tomato Production

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ARE Report No. 18
September, 1999

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The Bottom Line in Greenhouse Tomato Production

*Introduction*

A common marketing objective of commercial greenhouse growers is to sell their crop at a price sufficient to earn a profit. Greenhouse operators often grow tomatoes because the homegrown flavor and vine-ripe quality of greenhouse tomatoes are popular with consumers. Some greenhouse operators, however, believe that if they grow a superior quality crop then local buyers will purchase their output such that expected sales and profit goals will be realized. This approach is uncomplicated and is intuitively appealing. The competitive market environment for fresh tomatoes, however, does not necessarily provide growers with any assurances about sales volume, a sufficient price, or a favorable financial outcome. A greenhouse facility is an expensive structure to build, equip, and operate while greenhouse tomatoes are expensive to grow, harvest, and handle relative to many other agricultural commodities. High investment and production costs require that volume and/or price must be sufficiently large to ensure economic feasibility. Shoppers are willing to pay premium prices for tomatoes only if greenhouse tomatoes offer superior quality, value, taste, and freshness relative to alternative products. Traditionally, supermarket and institutional buyers have viewed greenhouse tomatoes as a high quality, niche commodity that expands the array of purchase choices available to shoppers. Many greenhouse growers believe that the superior quality offered by greenhouse tomatoes will allow the industry to capture a much larger share of the U.S tomato market. By 2005, industry leaders envision that the greenhouse tomato market share will expand from its current level of about 10% of total tomato supplies to 30% or more. Market share expansion requires that individually and collectively growers develop a marketing strategy, construct a business plan, expand market access, and maintain competitive costs yet deliver premium quality and good value to buyers.

While the cultural and technical production challenges offered by greenhouse tomato production are formidable, many individual North Carolina commercial greenhouse tomato operations fail because of inattention to market planning, total costs that regularly exceed revenue, and inadequate sales volume. Critical production and marketing challenges faced by greenhouse tomato producers include production of a superior product at a competitive cost, identification and communication of reasons why consumers and buyers should purchase greenhouse tomatoes through targeted advertising, evaluation of available marketing options prior to production activities, and exploitation of profitable market sales opportunities. The primary purpose of this report is to provide a guide for greenhouse tomato growers so that they can estimate their operational bottom line, that is, calculate the difference between gross revenue and total cost. At the end of this report, a complete greenhouse tomato budget is developed and presented in a series of tables. The sample budget identifies specific cost categories and estimates a net return for the production and sale of a spring greenhouse tomato crop. Growers can utilize the example budget to develop their own cost and return estimate. In addition, profitability depends on market success so a discussion about tomato marketing techniques and options is also presented.

Each marketing option and its associated sales strategy results in a different set of expected costs and returns for growers. An October 1998 survey of members conducted by the North Carolina Greenhouse Vegetable Grower Association (NCVGA) indicated that many members utilized multiple sales options to sell greenhouse vegetables. Most frequently, growers sold tomatoes and other greenhouse vegetables directly to consumers but also sold tomatoes to grocery stores and wholesalers. Direct sales to consumers provide growers with a premium price but oftentimes volume is limited. Direct sales also require that growers acquire related marketing skills such as pricing, merchandising, display arrangement, and selling. As local direct-to-consumer sales become more difficult, greenhouse tomato growers target larger volume outlets such as local wholesalers and supermarkets to expand sales. Wholesalers and supermarkets purchase large quantities of tomatoes but the greater volume is often sold at a lower per unit price when compared with the price received for direct sales to consumers. In addition, special handling services must be provided to high volume buyers. Added sales volume to local retailers and wholesalers offset other sales disadvantages so greenhouse growers usually find volume sales desirable. Nevertheless, growers must evaluate circumstances to determine if the lower price usually paid by wholesalers and supermarkets is sufficient to cover production and handling costs so that a profit is realized. Most greenhouse tomato growers recognize that marketing and costs interact and failure to consider both in a business plan will result in economic failure. In the next section, a brief overview of tomato market trends is presented. After tomato market trends are discussed, the next two sections examine the perishable marketing system and the set of available marketing options will be reviewed. The last section provides an estimate of possible greenhouse tomato revenue, cost, and net return for a North Carolina single structure, upright bag production system. The cost and return section can assist greenhouse tomato growers to develop cost and revenue estimates applicable to their own operation.

*Tomato Market Trends*

The U.S. food distribution network is among the most efficient in the world, allowing Americans, on average, to spend less than 12 percent of annual disposable income on food purchases (Elitzak, 1998). Each year, American fruit and vegetable companies and consumers spend about $100 billion to pack, grade, distribute, handle, and purchase fresh and processed fruits and vegetables. Government analysts estimate that farmers retain less than 20 percent of all fruit and vegetable expenditures, leaving about $80 billion spent annually on marketing tasks (McLaughlin and Perosio, 1994). Although the total retail sales value of U.S. fresh market tomato purchases (from supermarkets, independent grocery stores, direct farmer-to-consumer sales, exports, and institutions) is unknown, 1997 supermarket sales data revealed that Americans purchased nearly 1.3 billion pounds of fresh market tomatoes paying, on average, about $1.20 per pound. The retail value of fresh tomato sales by U.S. supermarkets in 1997 exceeded $1.5 billion. Americans consume nearly 19 pounds of fresh tomatoes each year, an amount that has increased 11 percent since 1988 (The Food Institute, 1998). It is likely that greenhouse tomato growers have benefited from increased fresh tomato consumption but relatively little information exists about the U.S. or North Carolina greenhouse tomato industry. Snyder (1998) has

reported that national greenhouse tomato acreage likely exceeded 750 acres in 1998, an amount that is 40 percent greater than the estimated 1996 acreage. Greenhouse tomato growers located in Colorado, Texas, Pennsylvania, and Arizona supply significant quantities of greenhouse tomatoes to U.S. markets. Colorado Greenhouses, a Fort Lupton, Colorado based greenhouse company and Village Farms who operate greenhouses in Virginia, Texas, New York, and Pennsylvania are believed to be the largest greenhouse tomato companies that operate under common ownership in the U.S. Colorado Greenhouses recently opened a 20-acre greenhouse facility in Grants, New Mexico and has announced plans to expand the New Mexico facility to 40 acres by March 2000. In North Carolina, tentative plans exist to build a 20 to 40 acre greenhouse facility in the Northwest region of the state. Based on greenhouse square footage criterion, the North Carolina greenhouse tomato industry is ranked as the eleventh largest in the U.S. (Snyder, 1998).

Recent increases in tomato consumption, greenhouse industry capacity expansion, and increased sales revenue might suggest an optimistic economic future for greenhouse tomato operators. However, greenhouse marketers and analysts are concerned about adverse grower price affects associated with increased production capacity and the growing spread between retail and grower prices. Increased greenhouse tomato supplies have originated from several sources. First, greenhouse growers located in Canada and Mexico have responded to increased U.S. sales opportunities by expanding their production capacity. Within the U.S., a similar pattern of increased production capacity has also occurred throughout several western U.S. states. Since 1996, Colorado, Arizona, and Texas greenhouse growers made substantial capital investment for the purpose of expanding their greenhouse production capability. The added capital investment has resulted in larger and more efficient greenhouse operations, which tends to reduce the average price paid to growers. Increased supply availability from Canada, Mexico, Spain, and Morocco plus increased availability of substitute products like cluster tomatoes grown in Holland and Israel have intensified sales competition and likely contributed to reduced grower prices as well. In recent years, many local greenhouse tomato growers have observed that prices paid to growers have declined, but they have not observed a corresponding reduction in retail tomato prices. Greenhouse tomatoes are often sold at a price premium when compared with field-grown tomatoes, but price premiums tend to limit sales volume. Unfortunately, detailed analysis of greenhouse tomato price and quantity trends is precluded since state and federal agencies collect only a limited amount of greenhouse price and quantity information.

While general tomato industry price and output trends are not directly applicable to the greenhouse tomato industry, some possible insights about greenhouse tomato trends may be obtained through analysis of U.S. fresh market tomato trends. Since 1992, the total output of U.S. grown tomatoes has decreased 8% while the average retail price for fresh market tomatoes has risen 25% (Lucier, 1999). During the 1992-1999 period, however, the average shipping point price (i.e., price paid to growers for packed and graded tomatoes) has declined 2%. If prices were adjusted for inflationary impacts, then the real price paid to growers for fresh market tomatoes would have declined about 13%. If observed field tomato trends were applicable to the greenhouse tomato industry, then it is

likely that increased quantities of greenhouse tomatoes were sold, retail prices increased significantly, and prices paid to greenhouse growers would have declined. Informal conversations with North Carolina greenhouse tomato growers suggest their experiences are consistent with a trend of generally declining prices paid to growers, increased sales volume, steady to increasing retail prices, and enhanced buyer power due to consolidation in the retail sector. Thus, despite industry sales expansion and growth and overall optimism about the greenhouse tomato industry, many greenhouse operators are concerned about the near-term financial viability of their operation and believe that numerous marketing and financial challenges face local greenhouse tomato growers. Additional sales and profit opportunities will exist for greenhouse tomato producers but the competitive market and price environment will limit returns such that greenhouse growers must intensify efforts to manage resources properly, ensure that costs per unit of output are low, revenues are sufficient to cover operating and fixed business expenses, and supplies are not excessive relative to consumption and demand levels. Greenhouse tomato production can be a profitable venture but extensive competition indicates that it will not be a profitable for all producers who build a facility and sell tomatoes.

*The Market System*

As the local greenhouse industry prepares for business in a new century, the greenhouse tomato marketing can be complex and confusing. Declining prices, seasonal price movements, and sales uncertainty lead to income uncertainty and market risk. Veteran greenhouse tomato producers know that past market success is not a good indicator of future success. North Carolina greenhouse tomato production is a risky undertaking since substantial investment and operating costs are incurred before price and sales volume are determined. Production risks are also common in greenhouse production because growers have few and expensive options if a pest or disease outbreak occurs. The limited array of chemical controls available to growers has encouraged some growers to examine organic production techniques. A recent survey of North Carolina-based natural food retailers and wholesalers conducted by Estes, et al. (1999) indicated that surveyed buyers were willing to pay a 25% price premium for organically grown vegetables. For greenhouse tomato growers, market success depends heavily on management of resources and information, knowledge about production costs, the flexibility to adapt to rapidly changing market situations, and communication with buyers about the benefits of buying greenhouse tomatoes at premium prices.

Experience and intuition are invaluable assets in the production and marketing of greenhouse tomatoes. Yet, experience and intuition fail at times because new competition emerges, consumer tastes, preferences, and buying habits change, and timely market information is unavailable. The traditional view of marketing was “sell what you have” while modern retailers require that an individual “have what sells”. The selling success of imported cluster tomatoes and grape tomatoes, for example, has motivated some domestic greenhouse tomato operators to harvest and sell U.S. grown cluster and grape tomatoes. The substantial price premium received for cluster and grape tomatoes will gradually decline, however, as growers increase available supply levels and customers tastes change. In the marketplace, shoppers purchase visually attractive tomatoes but also

intend to buy ‘packaged’ attributes with tomatoes such as better health, improved nutrition, flavor, and reduced cancer risk (from consumption of lycopene). Greenhouse growers must acquire information about what buyers really want when they purchase greenhouse tomatoes in order to expand sales. Buyer wants and needs differ by sales outlet. Consumers, of course, want well-shaped, ripe, attractive fruit that is flavorful. Greenhouse tomatoes are grown under optimum controlled climate conditions so they can provide buyers with tomatoes harvested at the peak of their taste and flavor. Intermediate handlers such as wholesalers or retailers prefer less mature fruit so shelf life can be extended, handling damage is minimal and marketing waste and loss is limited. Institutional buyers such as restaurants and cafeterias prefer limited quantities of items that offer low cost per serving but are less concerned with visual attributes. For all buyers in the market system, greenhouse production offers the advantage of out-of-season production so superior quality tomatoes are available for extended periods of the year. Knowledge about buyer preferences is just as important as knowledge about cultural practices and how to grade tomatoes.

Sometimes, acquisition of knowledge about marketing is thought to be an exercise only for the inexperienced seller or as a necessary evil done primarily out of fear. Inattention to market planning also arises from the belief that market success depends on luck, circumstances, or contacts. Too often, market success is viewed as the agricultural equivalent of “winning the lottery”, that is, financial reward is the result of circumstance rather than planning. Undeniably, luck influences price received and impacts financial success. More often, however, individuals who plan for marketing have regular success while people who do not plan or just hope to win the lottery will fail more often than succeed. Unfortunately, there is not one formula for marketing success that can be prescribed because management skills, market opportunities, and resource availability vary considerably among individuals. Marketing and greenhouse management consists of more art than exact science since it involves creative thought and application of multiple principles rather than a formula that to be used in all situations. Basic sales principles are not unique to the greenhouse industry but they are expected by buyers and should be followed. These basic tenets include open, frank, and regular communication between buyer and seller, develop market plans and contacts before planting, harvest and pack only superior quality tomatoes, have a general awareness of current price levels and trends, and deliver the quantity and quality promised.

Over time, successful marketers simply spend more time acquiring market information, assess the situation correctly more often, have intimate knowledge about production and marketing expenses, and manage their resources better than their competitors. The successful integration of skillful management with market information provides a competitive marketing advantage. In marketing, one common key to success seems to be an ability to put acquired knowledge to work. In effect, successful managers and sellers are able to work smarter and not just harder than their competitors. Smart work is the acquisition and use of relevant knowledge combined with skillful management of limited resources. Marketing cannot sell greenhouse tomatoes to people who do not want to buy them. The process of market planning involves collection of cost and expense information so that marketing options can be evaluated for sales and profit potential.

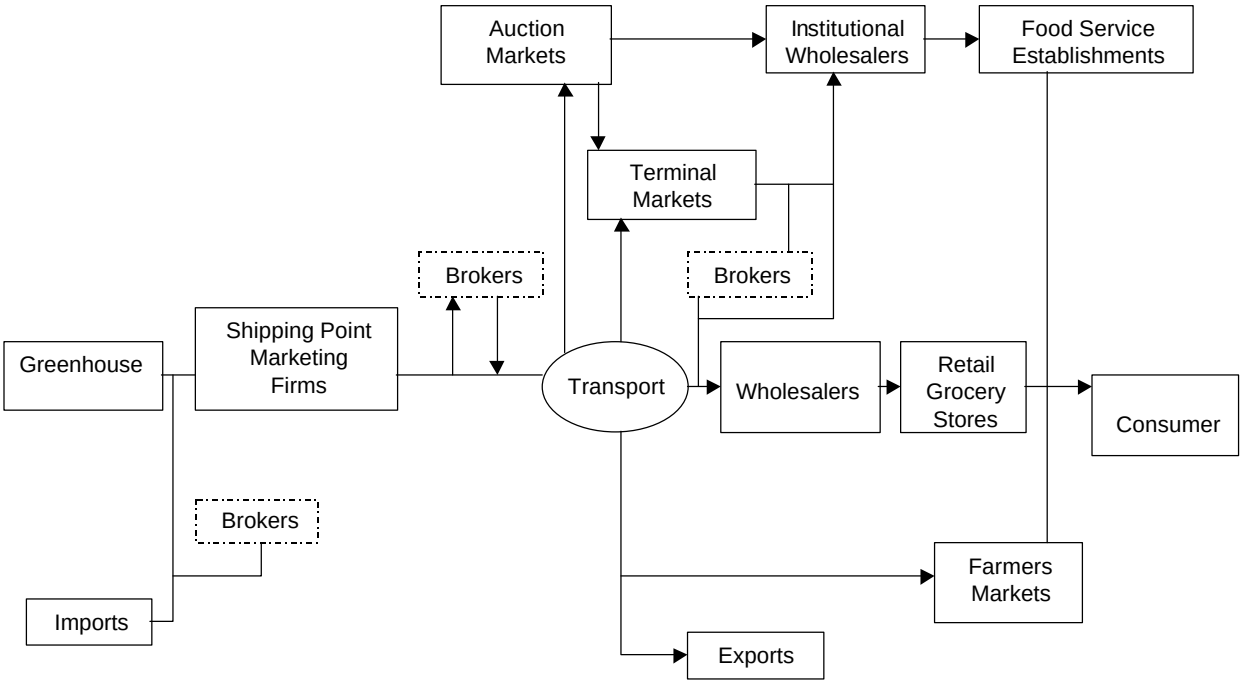
Unfortunately, creation of a market plan, analysis of costs, and working smarter will not always guarantee market success. However, it can increase the chance for success. The next section discusses basic marketing options available to greenhouse tomato growers.

*Marketing Options*

Marketing is the system of independent processes that coordinates production, handling, transport, pricing, and selling activities. Marketing should not be confused with selling. Selling is only one aspect of marketing, that is, the exchange of money for product while marketing involves planning, risk taking, financing, pricing, production, transportation, postharvest handling, and selling. In the marketing system, it is the responsibility of the individual who owns the tomatoes to locate a buyer, receive payment, arrange sale logistics, and arrange transport to the location desired by the buyer. The grower can perform these marketing functions or can hire someone else to perform them. Thus, selling responsibilities can be assigned but marketing responsibility remains with the owner of the tomatoes. In most situations, greenhouse tomatoes are sold to buyers located in nearby locations. For greenhouse operations located near cities, there is a sufficient customer base to sell tomatoes directly to customers at the house, at roadside stands or farmers' markets, or nearby grocery stores. In this instance, the marketing system is uncomplicated and there is only one ownership transfer. In this situation, there is little need for a market intermediary. However, direct sales still involve market research and planning because sales labor must be hired and trained, sales potential must be estimated, and temporary storage for unsold product must be built. Growers also must anticipate short-term glut situations and develop a marketing action plan for this contingency. If local market saturation occurs regularly, then sales to distant locations should be considered. Market intermediaries such as brokers and wholesale buyers can buy tomatoes from surplus regions and resell to customers in deficit supply areas. Through this market balancing process, low prices paid to suppliers in surplus areas are increased but high prices paid to growers in limited volume areas are reduced. Brokers and wholesalers earn income based on their knowledge of where surplus and deficit areas exist. Larger volume sellers such as chain stores often utilize the services of wholesalers, brokers, and their own buying staff to obtain the price, quantity, and quality needed. Brokers and wholesalers often arrange transportation from inconvenient production locations to more convenient purchase locations.

Simple as well as complex sales options are depicted in Figure 1. Of course, greenhouse growers may not have all sales options depicted in Figure 1 available to them. For example, the Faison, NC auction market does not permit greenhouse vegetables to be sold at the market while the Vineland, NJ auction market does. Also, greenhouse growers who attempt to sell tomatoes to institutional users such as fast food establishments, cafeterias or prisons likely face obstacles because greenhouse tomatoes often command premium prices. Institutional users monitor cost per serving values and premium quality items such as greenhouse tomatoes often do not satisfy the low cost per serving criteria sought by institutional users. Nevertheless, institutional buyers purchase specialty tomatoes such as extra large slicing tomatoes and utility tomatoes (No.2 grade) for specific clients, so growers should not ignore this marketing option.

Figure 1. U.S. Greenhouse Tomato Marketing System, 1999




For distant market sales, the sequence of product movement can be complex and may pose a challenge for individuals unfamiliar with the process. Inexperienced individuals must identify and locate brokers or other market intermediaries, learn standard operating procedures or market mechanics, box, grade, and label tomatoes according to industry standards, and coordinate transportation throughout the delivery system. Market coordination begins with the greenhouse grower and specific action plans should be developed prior to any production activities. It is also useful if growers develop sources to obtain current market price information, learn precise meanings for common sales terms so that communication is facilitated, and learn the process of how buyers source loads. Until ownership transfers, the grower remains responsible for marketing the tomatoes. Growers can employ additional individuals such as brokers, commission merchants, truckers, and shipper-packers to provide necessary marketing services or the owner can perform all necessary marketing tasks themselves. In most cases, brokers, commission merchants, and truckers work for either the seller or the buyer so they do not actually own the tomatoes. However, exceptions exist so growers must be clear as to the role that market intermediaries perform in the market process.

As depicted in Figure 1, typical sales options can be categorized into three main areas: 1) sales to local packers, shippers, retailers, specialty stores, or directly to consumers such as

farmers' markets; 2) sales to regional assembly point markets such as a cooperative, local grocery store, or an institutional user such as restaurants, cafeterias, or schools; and 3) bulk sales to national market buyers such as large chain stores, wholesalers, dealers, commission merchants, terminal market distributors, and commodity jobbers. Wholesalers are the group of buyers who purchase greenhouse tomatoes for the purpose of reselling them. There are, however, many categories and types of wholesalers. Wholesalers can be located in or near the production area or in or near a large consumption area (city). Most often, wholesalers are located in urban areas. Terminal market wholesalers are receivers located in produce receiving centers. Terminal markets companies specialize in receiving and distributing a wide variety of produce. Terminal markets are the urban counterpart to a shipping point market since receivers disassemble truckload shipments from production areas and redistribute smaller loads to urban buyers. Arriving loads are often presold to dealers on a terminal or wholesale market. In other instances, however, loads arrive from shipping point markets but buyers have not been identified. In this circumstance, sellers employ companies such as commission merchants to identify buyers, negotiate price, and arrange delivery. Commission merchants receive a percentage of the sales price in return for their services. Most loads of greenhouse tomatoes are sold to chain store retailers who are a special type of wholesale operator. Chain store warehouses receive and redistribute tomatoes for resale at affiliated stores. Most often, chain store warehouses receive shipments directly from large growers or shippers who can meet their larger volume sales requirements. If direct shipment quantities are inadequate, then many chain store buyers purchase additional greenhouse tomatoes from terminal market wholesalers. While sale terms are arranged prior to shipment to a terminal market, perishability considerations sometimes dictate that loads are shipped to terminal markets but sales terms and buyers are not identified as yet. In this circumstance, sellers employ companies such as commission merchants to locate buyers, negotiate price, and arrange delivery. Commission merchants receive a percentage of the sales price in return for their services. Distributors are a specific type of wholesaler that own special or exclusive rights to resell particular brands of tomatoes. For example, certain distributors may have the exclusive right to sell a specific brand of greenhouse tomato such as "Summer House" (from Colorado) in an area or region. Purveyors are a type of wholesale buyer that specialize in delivery of produce to foodservice companies such as restaurants, cafeterias, or prisons. Finally, a jobber is a wholesaler that specializes in delivering preordered loads of produce to a specific set of clients such as mom and pop grocery stores, hospitals, and dealers.

In the near future, greenhouse tomato growers likely will have an additional marketing option available. An increasing number of grocers are offering online grocery shopping via the World Wide Web. Online grocery shopping programs were initiated by several major supermarket chains such as Albertson's and WholeFoods (the parent company of Wellspring Stores in North Carolina) and include new entrants such as Peapods (Skokie, IL) and Webvan (San Francisco, CA) companies that only sell groceries via online shopping. At present, few companies offer perishable products such as fruits and vegetables online but this option is expected to change. Bill Gates, Microsoft Chairman, has stated his belief that online grocery shopping could account for one-third of U.S. food sales by 2005. Webvan, a company started by Louis Borders, co-founder of Borders bookstore chain, will construct food distribution and delivery centers in 26 U.S. markets over the next few years. Currently,

Webvan operates a 330,000 square foot facility in San Francisco but will begin warehouse operations in Atlanta during early 2000. Online shopping companies demand superior quality products since customers do not select individual items and want to establish their reputation of a high quality food supplier. Greenhouse tomatoes satisfy the niche of dependable, high quality products available for extended time periods.

While the quality, maturity, and shipping requirements can differ by option, wholesaler category, and type, a common feature is that volume requirements tend to increase when moving from local markets to distant markets. As volume increases, price becomes a more important consideration in the buy decision. Thus, each market option differs from another because of volume, price, quality, maturity, and frequency of delivery considerations. In all cases, buyers seek exceptional value (highest quality for the price), consistency in quality (both within and across loads), timely delivery of loads, and the longest possible shelf life to minimize waste and loss. Service requirements, long distance transport, and volume handling tend to increase costs so sellers must ensure that the price paid reflects the added cost provided. The wholesale marketing system is designed primarily to handle large quantities of product efficiently so limited volume products are not well suited for the wholesale network.

Which marketing option is best? The answer depends on the resources available, individual preferences, and the likelihood of profit. The advisability and feasibility of each option depicted in Figure 1 should be examined through collection of relevant market assessment information. What is relevant market assessment information? Marketing information is relevant and of value only if it is: (1) timely and applicable to a particular situation; (2) can be used to make a decision; (3) the added cost of acquiring the information is less than or equal to the anticipated benefit of using the information; and (4) it provides new information. At any point in the marketing system, growers need relevant marketing information such as: 1) how much volume is sold each week during the expected harvest period; 2) when are local and regional supplies expected to be most abundant or least available; 3) who and where are the competitors; and 4) what is the production cost per unit of output. Some basic market information can be obtained at a low cost through off-season visits to local retailers, attendance at educational programs, and tours to central receiving and distribution points. Personal visits to potential buyers can provide answers to basic volume questions, store or chain procurement practices, expected price, packaging, and delivery frequency information. Names of potential buyers, handlers, and brokers can be identified through purchase of the trade publications such as the Red Book (Vance Publishing, Inc.) or the Blue Book (Produce Reporter Company). In North Carolina, the North Carolina Department of Agriculture and Consumer Services market specialists (919-733-7136) can also assist individuals locate potential growers, truckers, distributors, brokers, wholesalers, and retailers. Conversations with other growers and county agents could support or refute possible market opportunities. In certain market circumstances, it may be more important when you have greenhouse tomatoes for sale than how many pounds are available for sale. For small volume growers, local and regional market niches likely exist. For niche markets, timing of crop availability is an important sales criterion. Finally, sales within the marketing network operate on reliability and trust. Reliability and trust result from regular and open communication between buyer and seller. If the buyer and seller

create a business and personal relationship, then it is easier to satisfy customer requirements. Collection of market information is both tedious and time-consuming but can be done well by dedicated individuals. Finally, supermarkets collect extensive data on their regular shoppers (via loyalty card programs and focus groups) so growers should request information from retailers that will help them satisfy consumer demand. Suppliers located near retail customers can provide personal added services at lower cost than more distant suppliers can and this marketing advantage should be recognized. Greenhouse growers are selling more than a box of tomatoes, that is, buyers also want delivery convenience, supply dependability, added shelf life, and reduced waste. Value added services could provide added incentive for the buyer. The feasibility of each marketing option and market service provided is determined, in part, by production and marketing expenses.

*Cost and Return Estimates*

There are a number of styles and types of greenhouse structures that can be built. In addition, there are a variety of production systems that can be utilized to raise greenhouse tomatoes. A 1998 survey of NCVGA members indicated that about one-half of the greenhouse growers utilized a hydroponic-type growing system while the remaining growers used the more traditional soil system. Hydroponic tomatoes can be grown using a variety of substrate materials including water, perlite, rockwool, peat, or combinatory substrates. Overall, hydroponic systems present a number of management and cultural practice challenges for growers but offer a number of advantages particularly in terms of product quality. For budget construction purposes, a mid-cost hydroponic upright peat bag system was assumed. House and equipment costs were obtained from several hydroponic greenhouse supply companies. Sufficient equipment and supplies were budgeted to produce a spring crop of tomatoes in a single 24’ by 96’ (2,304 square feet.) greenhouse. Greenhouse operators who plan to obtain most of their income from greenhouse tomatoes would need to operate multiple houses and also may need to produce both a spring and fall tomato crop. Greenhouse producers who expect to earn most of their income from the sale of greenhouse tomatoes likely would operate five or more greenhouses (about ¼ acre). In North Carolina, most greenhouses are operated as small-to-modest volume family owned businesses. In these situations, greenhouse revenue supplements other income and is not viewed as the only source of income.

In order to develop a cost and return estimate, many assumptions must be made. In particular, assumptions are made concerning the machinery and equipment purchased, the type of environmental controls utilized, the number and severity of pest and disease pressures, total yield, and price received. If one or more factors change, then it is likely that cost and return estimates will differ from values depicted in this budget. In addition, it is difficult to quantify important considerations such as the geographic location of the house, the production and marketing experience of the grower, quality, and personal sales contacts. Each factor could significantly change the cost and/or revenue figure presented. Finally, budget information can be organized in a variety of ways. Greenhouse cost information was estimated on a dollar per house and dollar per square foot basis. Additional information on production cost estimation procedures can be obtained through examination of “Budget Basics: Calculating Greenhouse Production Costs for Potted

Plants" written by Brian Whipker and Charles Safley (forthcoming Horticultural Information Leaflet available from the Department of Horticultural Science, North Carolina State University).

Cost and return budgets can be useful for growers because they help identify major cost and expense categories. Specific figures and amounts listed in the budget can assist growers in estimating the approximate magnitude of a value but can also be misleading because actual values can differ from assumed values. In addition, a number of cost categories could be added to the listed budget categories. In particular, detailed management, labor, taxes, and marketing expense categories could be itemized in the budget. For example, some owner-operators wish to include a salary expense for their time and effort devoted to growing and marketing the crop. Individual growers should make basic adjustments to the example greenhouse tomato budget presented. Recognizing various specific cost categories facilitates the budget adjustment process. First, growers should determine if the expense is a variable or fixed cost. Variable costs, often identified as operating expenses, are charges paid only if tomato production occurs. Variable costs change in proportion to the amount of production. Growers also refer to variable costs as cash or out-of-pocket expenses. Fertilizer cost is an example of a variable expense. The second major cost category is fixed cost. Fixed costs are expenses that are incurred irrespective of whether tomatoes are grown or not grown. Fixed costs do not vary with production or output but remain constant. An example of a fixed cost is property tax or insurance. This expense must be paid irrespective of the production decision. In general, fixed costs vary considerably across operations because of the wide variety of equipment, house, and environmental control available to growers. Alternatively, grower variable or operating costs tend to be similar because inputs such as seed or fertilizer are often purchased from common suppliers. Fixed costs plus variable costs equal total production costs. Some expenses can be either a variable or a fixed cost as the circumstance changes. For example, a permanent employee's salary is often designated as a fixed cost while seasonal or part-time employee wages are paid only if a crop is grown so they it is a variable expense.

Itemized expenses associated with the production of greenhouse tomatoes are contained in Tables 1, 2, and 3 and summary budget information is presented in Table 4. Table 5 contains summary cost and revenue information similar to Table 4 information but provides costs and returns calculated on a square foot basis. Cost and return information should be viewed as only one of many possible outcomes. Although cost and return estimates are believed to be typical and realistic, individual grower should adjust values to represent their specific situation and circumstances.

Costs for site preparation, structure, and specified equipment such as fans, a cooling system, and heaters are itemized in Table 1. Initial investment cost for the house totaled $16,335, or about $7.10 per square foot for the 24' x 96' greenhouse. Since the usable lives for the structure and equipment vary, the initial cost should be prorated over its expected useful life. Annual prorated initial investment costs were estimated to be $1,914. Total and annual investment costs could differ from the specified amount if a grower decided to install a more elaborate environmental control system, different

substrate materials were used, or multiple gutter-connected houses were built. Multiple greenhouses would increase the total expenditure but likely would reduce the prorated cost per square foot because economy gains would be realized and bulk quantity purchases would reduce the price paid per item.

Table 2 focuses on costs associated with the production of tomatoes. For the upright peat bag system assumed, two plants were set in each bag and a house population of 540 plants was used. Total plant propagation, cultural, harvest, and house fixed costs were estimated to be $6,620 for the tomatoes, or about $12.26 per plant. Specific variable cost estimates for selected items such as fertilizer, insecticide, and fungicide are not itemized for each application but instead represent total expenditures for the spring tomato crop. Usage rates, amounts, and costs for fertilizer and chemicals (if they are used at all) can differ significantly among operations so producers should consult with their county extension service agent to obtain a current list of recommended materials and application rates.

Table 3 lists unallocated greenhouse expenses such as general and administrative costs as well as delivery vehicle expenses. These expenses are general costs associated with operating a business and vary considerably among operations. Activities such as recordkeeping, tax document preparation, labor supervision, advertising mailings, flyers, and market research are often performed by the greenhouse owner-operator. If some tasks are performed by the owner-operator then they may not be cash expenditures but they are business costs. Growers would have to pay individuals to perform these tasks if they did not perform them so the business cost should be recognized. For budget estimation purposes, unallocated costs were estimated to equal $1,840 for a single greenhouse operation. Unallocated costs are often overlooked a business expense because of their indirect connection to either production or marketing expenditures. Growers need to monitor unallocated costs to ensure that all direct and indirect expenses are recognized in the budgeting process. Finally, annual ownership costs were estimated to be $2,314. Costs listed in the annual ownership category included the prorated annual investment cost of $1,914 (from Table 1) plus annual insurance and property tax payments.

Table 4 summarizes return and cost information. It was assumed that the total marketable yield for the spring crop of tomatoes was 8,400 pounds. Three distinct prices were used to estimate gross revenues. It was assumed that about two-thirds of the crop would be sold at an average price of $1.60 per pound with some tomatoes selling for as much as $1.90 per pound and as little as $1.30 per pound. For the entire crop, the weighted average price was expected to be $1.57 per pound. Total gross revenues were calculated to equal $13,188 (8,400 pounds times $1.57 per pound). As noted previously, plant production and operating costs were estimated to be $6,620, capital costs were estimated to be $721, annual ownership costs were $2,314, and unallocated expenses were $1,840. the summary of all expected costs was $11,495. Expected gross revenues exceeded estimated total costs by $1,693. This amount represents the budgeted net return above specified costs. This amount represents a partial internal rate of return of 15% on the amount of money spent ($11,495) and the risk assumed. For reader convenience, the figure listed in right side column of Table 4 is the percentage amount that each item

represents of gross revenue. For example, plant production and operating costs were 50% of gross revenues while unallocated costs were 14% of gross revenues.

Finally, Table 5 reformats Table 4 to include per square foot costs and returns since a number of greenhouse growers utilize this method of evaluating costs and returns. Actual production space utilized within an individual varies because of grower preferences but it is unlikely that a grower utilize all interior floor space for production purposes. Therefore, per square foot information was presented on a basis where 100% and 91% utilization of interior space was utilized for production.

*Revenue and Cost Assumptions*

While a wide range in marketable yield is possible, a conservative yield estimate of 15 pounds of marketable fruit per plant was utilized. Experienced and efficient greenhouse growers have reported marketable yield per plant in excess of 25 pounds per plant. With a modest yield assumption of 15 pounds per plant, the marketable yield from a single house would total 8,400 pounds of tomatoes. It was also assumed that 10 percent of the crop tomatoes would be sold for $1.90 per pound, approximately 70 percent of the crop would be sold for $1.60 per pound, and the remainder of the crop would be sold at an average price of $1.30 per pound. Of course, specific prices received will vary according to the sales option utilized and the harvest window. Direct sales to consumers will result in the highest price while sales to wholesalers and supermarkets likely will result in a lower average price (relative to the direct price). Similarly, producers will likely receive higher prices for early season tomatoes while prices will decline as supplies increase. Modest adjustments to the assumed volume and price estimates will change total gross revenue. For example, a 10 percent decrease in average yield (to 7,560 pounds) and average price (to $1.41 per pound) would result in gross revenues of $10,660, or a value that is below the expected cost of production. Of course, net returns vary from season-to-season and an expected net return of $1,693 per house does not mean that growers should expect to realize this amount of return every year. It is important to recognize that the expected return includes a reward for entrepreneurial risk. Production, marketing, and price circumstances change unexpectedly and quickly so expected gains can become monetary losses, particularly for inexperienced growers without well-defined sales opportunities and market options. The high quality product offered by greenhouse tomato growers is an excellent fit with a retailer's desire to offer shopper's superior quality items. However, the exact technical production requirements, intensive nature of the crop management system, and the substantial financial requirements of greenhouse tomato production suggest that greenhouse tomato production is suited for some but not all growers.

Table 1**.** Initial investment costs to construct a 24 foot' x 96 foot (2,304 sq. ft.) greenhouse tomato facility based on costs available in the summer of 1999*.

| Item | Initial cost ($) | Life (yr.) | Annual Cost ($) | Your Cost |
|---|---|---|---|---|
| *House construction*: | | | | |
| -24' x 96' frame & kit | $2,400 | 20 | $120.00 | |
| -base locking rail (330') | $450 | 20 | $23.00 | |
| -40' x 100' plastic (6 mil) 2x | $650 | 3 | $217.00 | |
| -inflation kit (tube & blower) | $150 | 5 | $30.00 | |
| -2 LP gas heater kit & pipe | $1,450 | 10 | $145.00 | |
| -30" fan jet system | $500 | 10 | $50.00 | |
| -cooling system (exhaust fans, guards, shutters (4)) | $900 | 10 | $90.00 | |
| -evap. pad & sump pump | $650 | 10 | $65.00 | |
| -environmental control sys. | $1,300 | 10 | $130.00 | |
| -low voltage wiring package | $350 | 10 | $35.00 | |
| -insulated house door & lock | $130 | 10 | $13.00 | |
| -shade cloth (60%) | $330 | 3 | $110.00 | |
| -ground landscape fabric | $375 | 3 | $125.00 | |
| -electrical control panel | $300 | 10 | $30.00 | |
| -plant support system (cable) | $750 | 10 | $75.00 | |
| *Site prep & ground gravel*: | $500 | 10 | $50.00 | |
| *Equipment:* | | | | |
| -nutrient injector system | $950 | 10 | $90.00 | |
| -additional timers (2) | $100 | 5 | $20.00 | |
| -substrate mixer eq. | $150 | 5 | $30.00 | |
| -electric generator back-up | $450 | 10 | $45.00 | |
| -water pump & filter | $1,950 | 10 | $195.00 | |
| -pH kit | $150 | 5 | $30.00 | |
| -sprayers, EC meter, misc. | $500 | 5 | $100.00 | |
| *Hired Labor***: | | | | |
| -house construction help | $720 | - | $72.00 | |
| -equipment installation help | $240 | - | $24.00 | |
| | | | | |
| **Total per house** | **$16,335** | | **$1,914** | |

* Initial investment costs for two 24 x 96 houses (4,600 sq. ft) would be slightly less than two times the single house cost since some expenses could be reduced or avoided. Excluded investment costs are a concrete slab foundation, a holding or product prep area, specialized equipment, and land acquisition. It is assumed that money is borrowed at 7 percent in order to build and equip the greenhouse and the annual interest expense for the house is included in the budget presented in Table 4.

**Hired labor is paid at an hourly rate of $10 per hour (including benefits and taxes).

Table 2. Greenhouse tomato production costs for an upright bag system, spring and summer harvest, 24' x 96' house, based on costs available in the summer of 1999

| Item | Unit | Quantity | Total Cost | Your Cost |
|---|---|---|---|---|
| *Plant propagation:* | | | | |
| -seed (hybrid) | seed count | 600 | $125 | |
| -trays & flats | case | .5 | $40 | |
| -substrate material | cubic meter | 8 | $8 | |
| -starter fertilizer | lbs. | 3 | $30 | |
| -labor & watering | hours | 30 | $180 | |
| -heat & electricity | house | - | $90 | |
| *Subtotal* | | | $473 | |
| *Cultural:* | | | | |
| -upright bags / pinebark / potting soil | each | 270 | $169 | |
| -bag watering | hours | 6 | $48 | |
| -move / set plants | hours | 12 | $96 | |
| -fungicide (Exotherm) | box (24) | 1 | $90 | |
| -insecticide | box (12) | 3 | $300 | |
| -fertilizer (4-18-38) | 375 lbs. | | $340 | |
| -fertilizer (15.5-0-0) | 80 lbs. | 1 | $100 | |
| -bumble bees | box | 2 | $300 | |
| -clips & training | box (3,000) | 1 | $60 | |
| -twine (nylon) | spool | 1 | $15 | |
| -prune / sucker | hours | 20 | $160 | |
| -misc. hand labor | hours | 20 | $160 | |
| *Subtotal* | | | $1,838 | |
| *Harvest:* | | | | |
| -pick / sort / grade | hours | 75 | $600 | |
| -labels & stickers | boxes | 1.5 | $50 | |
| -hauling / mkt. | hours | 20 | $160 | |
| -shipping box | each | 770 | $539 | |
| *Subtotal* | | | $1,349 | |
| *Overhead:* | | | | |
| -LP gas heat | gallon | 1,800 | $1,260 | |
| -electricity | 2,000 kwh /month | 6 | $720 | |
| -tissue analysis | house | 1 | $180 | |
| -bldg. taxes, insurance | house | 1 | $400 | |
| -permits, cell phone | house | 1 | $200 | |
| -repairs (2%) | house | 1 | $200 | |
| *Subtotal* | | | $2,960 | |
| ***TOTAL (this page)*** | | | **$6,620** | |

NOTE: Heating expenses will vary according to outside air temperatures and site specific characteristics. Repair costs increase as the age of the structure lengthens.

Table 3. Unallocated general business expenses associated with the production and marketing of spring tomatoes, prorated, 2,304 sq. foot house, based on costs available in the summer of 1999.

| Item | Unit | Quantity | Total Cost | Your Cost |
|---|---|---|---|---|
| *Delivery vehicle & hauling* | dollars | 1000 miles @ $.40 / mile | $400 | |
| | | | | |
| *General & Administrative Costs* | | | | |
| -record keeping | hours | 25 | Owner* | |
| -labor management | hours | 15 | Owner* | |
| -market research | hours | 15 | Owner* | |
| -subscriptions, trade shows, dues, & tours | hours | 15 | Owner* | |
| -health insurance (prorated) | dollars | | $400 | |
| -internet service | dollars | | $240 | |
| -advertising, mailings, & flyers | dollars | | $600 | |
| -product liability insurance | dollars | | $200 | |
| | | | | |
| | | | | |
| ***Total (this page)*** | | | **$1,840** | |

*Owner / operator contributions are not considered as cost payments or cash expenses but are included in net return. If hired labor is used to perform these tasks, then the wages paid should be listed as an expense.

Table 4. Estimated gross revenues, total costs, and net returns obtained from 24' x 96' greenhouse growing a spring crop of tomatoes based on summer 1999 prices and costs.

| Item | Unit | Price / Quantity | Total | Proportion of Revenue |
|---|---|---|---|---|
| ***Marketable Yield***: | | | | |
| -Early Season | 840 lbs. (10%) | $1.90 / lb. | $1,596 | 12% |
| -Mid-Season | 5,880 lbs. (70%) | $1.60 / lb. | $9,408 | 71% |
| -Late season | 1,680 lbs. (20%) | $1.30 / lb. | $2,184 | 17% |
| **Total Gross Revenue** | **8,400 lbs.** | **$1.57 / lb.** | **$13,188** | **100%** |
| | | | | |
| ***Operating Expenses:*** | | | | |
| -plant propagation | 540 plants | | $473 | 4% |
| -cultural costs | 540 plants | | $1,838 | 14% |
| -harvest | 540 plants | | $1,349 | 10% |
| -overhead | house | | $2,960 | 22% |
| Subtotal | | | $6,620 | 50% |
| | | | | |
| ***Capital Costs*:** | | | | |
| -interest on average value of house loan | 7% | $16,335 / 2 | $572 | 4% |
| -interest on operating loan (6 months) | 9% (4.5% for 6 months) | $6,620 / 2 | $149 | 1% |
| Subtotal | | | $721 | 5% |
| | | | | |
| ***Annual Ownership Costs:*** | | | | |
| -establishment cost | dollars | | $1,914 | 15% |
| -annual insurance | dollars | | $200 | 2% |
| -annual property taxes | dollars | | $200 | 2% |
| Subtotal | dollars | | $2,314 | 18% |
| | | | | |
| ***Miscellaneous Unallocated Costs*** | dollars | | $1,840 | 14% |
| | | | | |
| **Total Costs** | **dollars** | | **$11,495** | **87%** |
| | | | | |
| **Net Return to Owner/ Operator** | **dollars** | | **$1,693** | **13%** |

Table 5. Gross revenue, cost, and net return per square foot based on 100% and 91% of total space usable in a 24' x 96' greenhouse (2,304 sq. ft.) and production of a spring tomato crop, summer 1999.

| Item | Total | 100% of total square footage in house usable | 91% of total square footage in house usable |
|---|---|---|---|
| ***Marketable Yield***: | | | |
| **Total Gross Revenue** | $13,188 | $5.72 | $6.29 |
| | | | |
| ***Operating Expenses:*** | | | |
| -plant propagation | $473 | $0.20 | $0.23 |
| -cultural costs | $1,838 | $0.81 | $0.87 |
| -harvest | $1,349 | $0.59 | $0.64 |
| -overhead | $2,960 | $1.28 | $1.41 |
| Subtotal | $6,620 | $2.88 | $3.15 |
| | | | |
| ***Capital Costs*:** | | | |
| -interest on house loan | $572 | $0.25 | $0.27 |
| -operating loan | $149 | $0.06 | $0.07 |
| Subtotal | $721 | $0.31 | $0.34 |
| | | | |
| ***Annual Ownership Costs:*** | | | |
| -Establishment cost | $1,914 | $0.83 | $0.91 |
| -annual insurance | $200 | $0.09 | $0.10 |
| -annual property taxes | $200 | $0.09 | $0.10 |
| Subtotal | $2,314 | $1.01 | $1.11 |
| | | | |
| ***Miscellaneous Unallocated Costs*** | $1,840 | $0.80 | $0.88 |
| | | | |
| **Total Costs** | **$11,495** | **$5.00** | **$5.48** |
| | | | |
| **Net Return to Owner/ Operator** | **$1,693** | **$0.73** | **$0.81** |

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